

## **REMARKS/ARGUMENTS**

In response to the pending Office Action of May 15, 2008, Applicants present the following arguments and amendments. The present amendments are requested solely for the purpose of more clearly describing and claiming the present invention and do not introduce any new matter. Applicants submit that in light of the arguments presented and amendments requested, this application is in condition for allowance. Accordingly, entry of these amendments, reconsideration of all pending rejections and objections, and passage to allowance is respectfully requested. With the entry of this amendment, claims 1-3, 6-20, 26 and 28-49 are pending herein.

### **Amendments to the specification**

Amendments to paragraphs [0061], [0069], [0071], and [0072] are requested to correct minor typographical errors. The requested amendments enhance clarity and do not provide any new matter.

### **Amendments to the claims**

Amendment of claim 1 is requested to more particularly point out and distinctly claim the present invention by providing a "silicon nanofilm or the lithium alloy thereof" having "a thickness selected over the range of 100 nm to 200 nm." Support for the requested amendment is provided throughout the specification, for example in paragraph [0046], and in the experimental results provided in Examples 1 and 4 (See, e.g., paragraphs [0058] and [0068]) of the published application. The requested amendment of claim 1 does not introduce any new matter.

Claim 5 is canceled without prejudice to the subject matter therein. Applicants expressly reserve the right to pursue the subject matter of claim 5 as originally presented.

Amendment of claim 6 is requested to more particularly point out and distinctly claim the present invention by providing a silicon nanofilm that is amorphous. Support for the requested amendment is provided throughout the specification, for example in paragraph [0046] of the published application. The requested amendment of claim 6 does not introduce any new matter.

Claims 21-25 are canceled without prejudice to the subject matter therein. Applicants expressly reserve the right to pursue the subject matter of Claims 21-25 as originally presented.

New claims 37 and 47 are added, which provide a silicon nanofilm, "wherein the silicon nanofilm comprises both crystalline and amorphous domains." The new claims are added to more particularly point out and distinctly claim the present invention. Support for new claims 37 and 47 is provided throughout the specification, for example in paragraph [0046] of the published application. New claims 37 and 47 do not add any new matter.

New claim 38 is added to more particularly point out and distinctly claim the present invention by providing "an electrode for a secondary electrochemical cell comprising a silicon nanofilm or a lithium alloy thereof, wherein the silicon nanofilm or the lithium alloy thereof is not greater than about 200 nm thick, said electrode having a reversible specific capacity of at least 2000 mAh/g." Support for new claim 48 is provided, for example, in Claim 1 as originally presented, and paragraphs [0015], [0019] and [0047] of the published application. New claim 48 does not introduce any new matter.

New claims 39-46 are added to more particularly point out and distinctly claim the present invention. Support for new claims 39-46 is provided by claims 2-3, 5-7, 26, 28,

and 36, respectively, as originally presented. New claims 39-46 do not introduce any new matter.

New claim 48 is added to more particularly point out and distinctly claim the present invention by providing an electrode for a secondary electrochemical cell having “a reversible specific capacity of at least 2500 mAh/g.” Support for new claim 48 is provided, for example, in paragraph [0047] of the published application.

New claim 49 is added to more particularly point out and distinctly claim the present invention by providing an electrode “having an average capacity loss per cycle of 0.3% or less for cycles greater than 20.” Support for new claim 38 is provided, for example, in the plot showing capacity (mAh/g) versus cycle number in Figure 9 of the published application. New claim 49 does not introduce any new matter.

#### Rejections under 35 U.S.C. § 112

Claim 6 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter of the present invention. Applicants have amended claim 6 to clarify that the silicon nanofilm is amorphous. In light of the present amendments, Applicants respectfully request reconsideration and withdrawal of the rejection of claim 6 under 35 U.S.C. § 112, second paragraph.

#### Rejections under 35 U.S.C. § 102

Claims 1, 2, 5, 6, 26, 28, and 36 are rejected under 35 U.S.C. § 102(a) as being anticipated by Park (US 2002/0048705). In support of the pending rejections, the Examiner asserts:

“... Park discloses a electrochemical cell comprising an electrode comprising a silicon layer [0014]. It is noted that lithium forms an alloy with silicon during

charging/discharging [0012]. Table 1 discloses that the thickness of Si layer is between 70 and 200 angstroms...”

Applicants respectfully disagree with the Examiner’s characterization of the cited reference and rejections under Section 102. However, for the sole purpose of expediting passage to issuance, Applicants request amendments of the rejected claims. Accordingly, reconsideration and withdrawal of all pending rejections under 35 U.S.C. § 102(a) is respectfully requested in light of the present amendments and the following arguments.

The disclosure in Park is limited to anodes comprising Si nanofilms having thicknesses selected over the range of 5 to 30 nm. Anodes comprising silicon nanofilms having thicknesses selected over the range of 100 to 200 nm, as provided in amended claims 1-3, 6-7, 26, 28, and 36-37, are not disclosed in Park. Moreover, Park does not provide any suggestion or motivation to utilize Si nanofilms having thicknesses greater than 30 nm. Rather, the disclosure in Park expressly teaches against the use of Si thin films having thicknesses greater than 30 nm for anodes in lithium batteries. For example, Park discloses an anode active material that is a multiple-layer thin film comprising a Si layer and an Ag layer, wherein the Si layer is 50-250 angstroms (5-25 nm) thick (see, e.g. [0035] and Table 1). Additionally in paragraph [0051], Park discloses an anode thin film of “pure Si deposited ... to a thickness of 300 angstroms” (30 nm). Furthermore, in paragraph [0035], Park recites, “If the thickness of stacked Si layers is greater than 250 angstroms, the volumetric expansion of silicon cannot sufficiently [be] suppressed.”

Not only are the thicknesses of the silicon nanofilms of the present invention (100-200 nm) outside of the thickness range disclosed by Park (5-30 nm), the present invention provides silicon nanofilms having thicknesses three to seven times larger than those disclosed in Park. Therefore, Applicants assert that Park does not anticipate the

electrodes of the present invention. [See, Prior Art Which Teaches a Value or Range That is Very Close to, but Does Not Overlap or Touch, the Claimed Range Does Not Anticipate the Claimed Range, MPEP 2131.03, III; “[A]nticipation under § 102 can be found only when the reference discloses exactly what is claimed,” *Titanium Metals Corp. v. Banner*, F.2d 775, 227 USPQ 773 (Fed. Cir. 1985)]. Applicants assert that Park does not anticipate claims 1-3, 6-7, 26, 28, and 36-37 because the reference fails to disclose, teach or suggest, all the limitations of the rejected claims as amended herein, and the missing limitations are well outside the grasp of the skilled artisan at the time of the invention. Accordingly, Applicants request reconsideration and withdrawal of the present rejections under 35 U.S.C. § 102(a).

Rejections under 35 U.S.C. § 102(a) or § 103(a)

Claims 3 and 7 are rejected under 35 U.S.C. § 102(a) as anticipated by or, in the alternative, under 35 USC § 103(a) as obvious over Park. Applicants respectfully disagree with the Examiner’s characterization of the cited reference, and request reconsideration and withdrawal of the pending rejections in light of the present amendments and following arguments.

The arguments above are reiterated. Specifically, Park expressly teaches against the use of silicon thin films having thicknesses greater than 30 nm as anodes for lithium batteries. In view of this teaching, Applicants submit that it is not predictable to arrive at silicon thin films having thickness greater than 30 nm from Park as this reference characterizes silicon films having thicknesses greater than 30 nm thick as having properties undesirable for use in lithium batteries. Moreover, the silicon thin films of the present invention are three to seven times thicker than the maximum thickness of the silicon thin films disclosed in Park. Therefore, the silicon thin films of the present invention are not a predictable extension of Park given that this reference expressly teaches against the claimed invention by suggesting that silicon thin films having a thickness selected over the range of 100 nm to 200 nm would be inferior if not

inoperable in lithium batteries. [See, Examination Guidelines for Determining Obviousness Under 35 U.S.C 103 in View of the Supreme Court decision in KSR International Co. V. Teleflex Inc., Fed. Register, Vol. 72. No. 195 (2007); “When considering obviousness of a combination of known elements, the operative question is whether the improvement is more than the predictable use of prior art element according to their established functions.”]. Claims 3 and 7 are not rendered anticipated by or obvious over the cited reference because Park fails to teach, enable, or suggest all the limitations of the amended claims. Accordingly, Applicants respectfully request reconsideration and withdrawal of the pending rejections under 35 U.S.C. § 102(a) or § 103(a).

#### Patentability of New Claims 37-49

New claims 37 and 47 introduce a further limitation on the material properties of silicon nanofilms of the present invention by providing silicon nanofilms comprising “both crystalline and amorphous domains.” Claim 37 depends from Claim 1 and Claim 47 depends from Claim 38. Applicants submit that Claims 37 and 47 are allowable.

New claim 38 introduces a further limitation on the electrochemical properties of the present invention by providing “an electrode for a secondary electrochemical cell comprising a silicon nanofilm or a lithium alloy thereof, wherein the silicon nanofilm or the lithium alloy thereof is not greater than about 200 nm thick, said electrode having a reversible specific capacity of at least 2000 mAh/g” to further distinguish the performance of these electrodes over those of Park. The electrodes comprising silicon nanofilms or lithium alloys thereof of the present invention demonstrate reversible specific capacities of at least 2000 mAh/g. Applicants note that the specific capacities of the electrodes disclosed in Park are unknown because Park presents capacities of their electrodes in units of  $\mu\text{Ah}$ , and does not provide further information (ie dimensions or mass) enabling the conversion of these units to those of the present invention. Applicants note, however, that the electrodes of Park incorporate layers of silver in

addition to layers of silicon, and silver reacts with lithium upon charging resulting in a much lower reversibility than silicon (e.g. [0036] in Park). The teaching in Park to incorporate thin films of silver in the anode active material diminishes and does not enhance the specific capacity. Therefore, the electrodes of the present invention most likely have a larger capacity than those in Park, which comprise layers of both silver and silicon. Additionally new claims 39-49 depend from new claim 38. Therefore, Applicants submit that Claims 38-49 are allowable.

Regarding new claim 49, Applicants note that claim 49 introduces a further limitation on the cycling characteristics of the electrodes of the present invention by providing an electrode "having an average capacity loss per cycle of 0.3% or less for cycles greater than 20" to further distinguish the present electrodes over those of Park. Applicants note, as shown in Figure 9, that the electrodes of the present invention display an average capacity loss per cycle that is less than the electrodes of Park (see, e.g., Fig. 3 in Park), and in some cases more than four times smaller than the electrodes of Park. Applicants assert that the silicon nanofilms of the present invention exhibit improved cycling characteristics over that of Park. Applicants submit that new Claim 49 is allowable.

## **CONCLUSION**

In view of the foregoing, this case is considered to be in condition for allowance and passage to issuance is respectfully requested. If new issues of patentability are raised, the Examiner is invited to call and arrange for an opportunity to discuss these issues via telephone interview.

It is believed that excess claims fees in the amount of \$150.00, and a one month extension of time and corresponding fee of \$60.00 is required for this submission. Therefore, payment in the amount of \$210.00 is being made via the Electronic Filing System with this submission. If any additional fees or further extensions of time are required, however, please also deduct all additional fees for this submission and any extension of time required from Deposit Account No. 07-1969.

Respectfully submitted,

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